Geophysical Research Abstracts
Vol. 15, EGU2013-8027-2, 2013
EGU General Assembly 2013

ModABa MODEL: ANNUAL FLOW DURATION CURVES ASSESSMENT IN EPHEMERAL BASINS

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A representation of the streamflow regime for a river basin is required for a variety of hydrological analyses and engineering applications, from the water resource allocation and utilization to the environmental flow management. The flow duration curve (FDC) represents a comprehensive signature of temporal runoff variability often used to synthesize catchment rainfall-runoff responses. Several models aimed to the theoretical reconstruction of the FDC have been recently developed under different approaches, and a relevant scientific knowledge specific to this topic has been already acquired. In this work, a new model for the probabilistic characterization of the daily streamflows in perennial and ephemeral catchments is introduced. The ModABa model (MODel for Annual flow duration curves assessment in intermittent BAsins) can be thought as a wide mosaic whose tesserae are frameworks, models or conceptual schemes separately developed in different recent studies. Such tesserae are harmoniously placed and interconnected, concurring together towards a unique final aim that is the reproduction of the FDC of daily streamflows in a river basin. Two separated periods within the year are firstly identified: a non-zero period, typically characterized by significant streamflows, and a dry period, that, in the cases of ephemeral basins, is the period typically characterized by absence of streamflow. The proportion of time the river is dry, providing an estimation of the probability of zero flow occurring, is empirically estimated. Then, an analysis concerning the non-zero period is performed, considering the streamflow disaggregated into a slow subsuperficial component and a fast superficial component. A recent analytical model is adopted to derive the non zero FDC relative to the subsuperficial component; this last is considered to be generated by the soil water excess over the field capacity in the permeable portion of the basin. The non zero FDC relative to the fast streamflow component is directly derived from the precipitation duration curve through a simple filter model. The fast component of streamflow is considered to be formed by two contributions that are the entire amount of rainfall falling onto the impervious portion of the basin and the excess of rainfall over a fixed threshold, defining heavy rain events, falling onto the permeable portion. The two obtained FDCs are then overlapped, providing a unique non-zero FDC relative to the total streamflow. Finally, once the probability that the river is dry and the non zero FDC are known, the annual FDC of the daily total streamflow is derived applying the theory of total probability. The model is calibrated on a small catchment with ephemeral streamflows using a long period of daily precipitation, temperature and streamflow measurements, and it is successively validated in the same basin using two different time periods. The high model performances obtained in both the validation periods, demonstrate how the model, once calibrated, is able to accurately reproduce the empirical FDC starting from easily derivable parameters arising from a basic ecohydrological knowledge of the basin and commonly available climatic data such as daily precipitation and temperatures. In this sense, the model reveals itself as a valid tool for streamflow predictions in ungauged basins.